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DATE: October 23, 2009

TO: Greg Powell, EPA/ERT Work Assignment Manager

THROUGH: Dennis Miller, REAC Program Manager

FROM: Ken Woodruff, REAC Task Leader K.W.

SUBJECT: TRIP REPORT –MULTI-MEDIA SAMPLING, SMOKEY MOUNTAIN SMELTER SITE, KNOXVILLE, TENNESSEE
WORK ASSIGNMENT # 0-182

PURPOSE

The purpose of this investigation was to conduct multi-media sampling at and near the Smokey Mountain Smelter site near Knoxville, Tennessee (TN). The results will be used to help prepare Hazard Ranking System (HRS) documentation for possible inclusion of the site on the National Priorities List (NPL). Sampling media included groundwater in nearby domestic wells, soil, surface water, sediment and waste piles. Work was carried out by staff of the Response Engineering and Analytical Contract (REAC) in consultation with the Environmental Protection Agency Environmental Response Team (EPA/ERT) and in cooperation with Tetra Tech™, the EPA Region IV Superfund Technical Assessment and Response Team (START).

BACKGROUND

The Smokey Mountain Smelter site is located at 1508 Maryville Pike, just south of the City of Knoxville, TN (Figure 1). From the early 1920s through the 1970s the site was used for fertilizer manufacturing before being converted to a secondary aluminum smelter. Anecdotal evidence suggests that the site may have also been used for iron or steel production for a short time following the cessation of fertilizer production. Finally, portions of the approximately 14-acre site were used as a mixed waste dump before being abandoned. A large building, now structurally unstable, housed the rotary and casting furnaces. Piles of aluminum smelting waste remain in the building, and used bag filters and bag filter dust are present in the "bag house" area adjacent to the site building. Aluminum smelting waste, and possibly other mixed waste, also covers much of the area south of the building. Older maps (Figure 2) show that two ponds, located immediately south of the building, were present during fertilizer production but were later filled in. The small stream (Lagoon Branch) feeding the former ponds has been diverted to the east side of the site where a newer impoundment now exists (Figure 3). The stream leaves the present pond and the site as the SMS Branch of the East Fork of Flenniken Creek (SMS Branch) where it flows into the East Fork of Flenniken Creek and ultimately into the Fort Loudon Reservoir on the Tennessee River.

In October 1997, the Tennessee Department of Environment and Conservation (TDEC) completed an assessment of the site that indicated the presence of metals, polyaromatic hydrocarbons (PAHs) and ammonia. Anecdotal evidence had suggested the presence of low-level radioactive waste because of the proximity of the Oak Ridge nuclear facility. Following the preliminary assessment by TDEC, EPA Region IV requested a public health assessment of the site by the Agency for Toxic Substances and Disease Registry (ATSDR). The agency's subsequent report indicated that the contaminants in the waste piles did not pose a public health hazard under "current conditions". However, the report indicated that the impact of site contaminants to ambient air quality and to groundwater had not been investigated. Likewise, the specific composition and reactivity of the waste piles and the composition of the residual baghouse dust had not been determined.

In October 2006, REAC personnel completed the following work at the site:

- A site grid was established followed by a surface radioactive scan of the waste piles. Samples of soil or waste were collected for gamma spectral analysis and analyses of isotopic uranium (U-234, U-235, U-236, U-238), thorium (Th-227, Th-228, Th-230, Th-232), and plutonium (Pu-238, Pu-239). The gamma spectral analysis included identification and quantification of actinium (Ac)-228, bismuth (Bi)-214, cobalt (Co)-60, cesium (Cs)-137, potassium (K)-40, lead (Pb)-212, Pb-214, Th-234, and tantalum (Tl)-208.

- Waste from selected locations was sampled for dioxins/furans.

- Various site materials were sampled for the presence of asbestos, and paint chips were collected for lead analysis.

- Water samples were collected from a seep near the western edge of the waste piles, the SMS Branch just downstream from the site, the pond bordering the eastern portion of the site, and two offsite springs. A stream background sample was also collected from the East Fork of Flenniken Branch, upgradient from the site. Samples were analyzed for alkalinity, chloride (Cl), cyanide (CN), fluoride (Fl), nitrate (NO_3), nitrite (NO_2), total phosphate (PO_4), and total dissolved solids (TDS).

In December 2006 REAC conducted the following additional work at the site:

- Collected continuous soil cores at 25 locations; each five-foot long core was scanned on site for alpha, beta and gamma radiation, then composited and subsequently analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated bi-phenols (PCBs), target analyte list (TAL) metals, dioxins/furans, ammonia, nitrate, nitrite, cyanide, and total carbon.

- Installed seven temporary groundwater monitor wells that were sampled for VOCs, SVOCs, pesticides/PCBs, TAL metals, alkalinity, chloride, cyanide, fluoride, ammonia, nitrate, nitrite, total phosphorus, and total dissolved solids.

- Resampled the seep, springs and all surface water locations sampled in the October 2006 mobilization. Ammonia, VOCs, SVOCs, and pesticides /PCBs were added to the analyte list.

- Completed a terrain conductivity and magnetic survey across the outside waste piles to determine the presence of buried drums.

- Collected samples from the waste piles inside the site building for a reactivity test conducted at the REAC Engineering Evaluation Unit (EEU) to determine the potential for generation of ammonia and cyanide gases during precipitation events.

The October and December 2006 activities and results are discussed in a Lockheed Martin/REAC July 2007 Trip Report. From February to May 2007, a local surveying firm under contract to REAC, completed a boundary and topographic survey of the site which was provided to EPA under separate cover.

METHODS

Both REAC and START personnel participated in sampling activities. However, all samples were turned over to START personnel for processing and submission to contract laboratories, or to an EPA laboratory, depending on the analysis.

Domestic Well Sampling

Nine domestic wells (Figure 1), including one background well (sample SMS-01-PW), were sampled for VOCs, SVOCs, pesticides, PCBs, and chloride. Chloride may serve as a groundwater tracer from the site because of the salts used in the smelting process. High chloride concentrations were detected in downgradient stream and spring samples during the 2007 ERT/REAC sampling.

One domestic well sample (SMS-09-PW) was collected from a kitchen tap and all other samples (SMS-01-PW through SMS-08-PW) were collected from outside spigots. All sampling points were located before any treatment systems. The systems were purged for at least 10 minutes before a sample was collected, depending on the volume of the pressure tank. Well depths and construction details were generally not known.

Soil Sampling

Soil samples were collected from four locations within the nearby housing complex northeast of the site (Figure 1). A clean dedicated stainless steel trowel was used to collect samples into 8-ounce (oz) glass jars at depths of 0- to 3-inches at three locations (SMS-02-SF, SMS-03-SF, SMS-04-SF) for SVOCs, pesticides/PCBs, TAL metals and cyanide. Samples for VOC analyses were collected using Encore™ samplers. Both surface ("SF") and depth ("SB") samples were collected at background location SMS-01 using a clean hand auger to collect the depth sample from 18 to 24 inches below grade.

Outside Waste Pile Sampling

Samples SMS-01-WA, SMS-02-WA, SMS-03-WA and SMS-04-WA were collected from the outside waste piles at or near former soil boring locations (Lockheed Martin, 2007) as selected by TetraTech personnel. A clean hand auger was advanced to maximum depths of 2 feet at each location. Samples were collected from the auger using Encore samplers for VOC samples, and dedicated stainless steel spoons for collection of SVOCs, pesticides, PCBs, TAL metals and cyanide samples into 8-oz jars.

Inside Waste Pile Sampling

Two separate waste piles are present inside the site building and appear to consist of aluminum dross and some salt cake. One pile is located in the southwest corner of the building's lower level, and the other pile occupies the northern side of the building on the upper level. A small excavator was used to open the piles so that fresh samples could be collected from their interior. Samples for VOC analysis were collected directly from the lower pile (sample SMS-05-WA) and at two locations from the upper pile (samples SMS-06-WA, SMS-07-WA) using encore samplers. Samples for SVOCs, pesticides, PCBs, TAL metals and cyanide analyses were collected into 8-oz jars from the same locations using dedicated stainless steel trowels.

Additional samples were collected from the upper, middle and lower one-third of both waste piles with the two samples from each of the same levels composited in stainless steel bowls. A separate sample was also collected from a layer in approximately the middle of the lower pile that contained clusters of blue-green amorphous material, less than 0.5 inches in diameter. The three composite samples and the single sample were shipped in 5-quart plastic bags to the REAC Engineering Evaluation Unit (EEU) for reactivity testing.

Following sampling, the interior waste pile dimensions were measured in order to calculate an approximate volume of waste. These data were provided to START personnel.

Surface Water Sampling

Surface water samples SMS-02-SW and SMS-03-SW were collected in the East Branch of Flenniken Creek downgradient of the site and sample SMS-04-SW was collected from a leachate seep at the southern end of the exterior waste piles (Figure 1). Samples SMS-02-SW and SMS-03SW were collocated with sediment

samples SMS-02-SW and SMS-03-SW. Sample SMS-01-SW was considered a background sample. Samples were collected directly into 1-liter (L) amber jars for analysis of SVOCs, pesticides and PCBs, and directly into 40-milliliter (mL) vials for analysis of VOCs. Samples for TAL metals and cyanide analyses were collected into separate 1-L polyethylene bottles and preserved with nitric acid and sodium hydroxide respectively.

Sediment Sampling

Sediment samples were collected at depths of 0 to 3 inches in the East Branch of Flenniken Creek, downgradient of the site where a seep enters the stream (SMS-02-SD) and approximately 20 feet downstream of the seep discharge (SMS-03-SD). Encore samplers were used to collect samples for VOC analysis and clean dedicated stainless steel trowels were used to collect samples directly into 8-oz jars for analysis of SVOCs, pesticides, PCBs, TAL metals and cyanide. A background sediment sample was also collected at location SMS-01-SD (Figure 1).

Reactivity Test

On arrival at the REAC EEU laboratory, a MultiRae™ instrument with calibrated ammonia (NH_3) and hydrogen cyanide (HCN) detectors was used to make head-space measurements in the plastic bags containing the waste samples. Samples were sieved through a 1 millimeter (mm) sieve to remove debris and then mixed in a reaction vessel with water simulating precipitation east of the Mississippi River. The mix ratio was 100 grams of sample to 50 milliliters of water. Concentrations of NH_3 and HCN were measured at ambient conditions and the temperature in the reaction vessel was then gradually increased to a final temperature of approximately 50 degrees Centrigrade (°C). Measurements were made of NH_3 and HCN at approximately 1-minute intervals during the heating process. The procedures were the same as those used for reactivity testing of the samples from the 2006 mobilization and are attached as Appendix A.

RESULTS

Analytical results for analyses of pesticides, PCBs, SVOCs, and VOCs are given in Tables 1 through 4, respectively. If duplicate samples were collected, the higher of the two values is shown. Results, are also discussed in the July 20, 2009 Tetra Tech draft Trip Report previously submitted to the EPA Remedial Project Manager (RPM). To avoid excessive duplication of effort, selected tables have been extracted from that report as Appendix B and should be consulted for the analytical results. The Tetra Tech report also addresses maximum contaminant levels (MCLs) and EPA regional screening levels (RSLs) that are applicable to the site.

Domestic Well Samples

A trace amount of the pesticide 4,4'-DDT (Table 1) below reporting limits ("J" qualifier) was detected in domestic well sample SMS-08-PW. Aroclor 1254 (Table 2) was found at an estimated concentration of 1.4 micrograms/liter (µg/L) in SMS-09-PW. The SVOC phenol (Table 3) at a concentration of 8 µg/L and trace amounts of anthracene, fluorene, and phenanthrene below reporting limits were detected in domestic well sample SMS-09. No other organic compounds were found in the domestic well samples and chloride concentrations were all single-digit values.

Surface Soil Samples

Sample SMS-03-SF collected at the housing development contained 4,4'-DDT at a concentration of 15 micrograms/kilogram (µg/kg). Trace amounts of dieldrin below reporting limits were found in the samples from all three housing development locations (SMS-02-SF, 03-SF, 04-SF). A trace amount of endosulfan II was also detected in sample SMS-02-SF. A trace amount of 4,4'DDE and a trace amount of gamma-chlordane were detected at locations SMS-03-SF and SMS-04-SF, respectively.

The SVOCs acetophenone, benzo(a)pyrene, benzo(b)fluoranthene and chrysene were detected below reporting limits in the soil background sample SMS-01-SF (Table 3). However, the benzo(a)pyrene

concentration (47 J) exceeds the RSL of 15 µg/kg. No PCBs, VOCs or SVOCs were detected in the other housing development samples.

Arsenic concentrations (Appendix B) exceeded the RSL in all soil samples and the manganese concentration in sample SMS-030-SF equals the RSL value of 1,800 mg/kg (Tetra Tech, 2009).

Subsurface Soil Samples

The SVOC acetophenone at an estimated concentration of 77 µg/kg was the only compound identified in background subsurface soil sample SMS-01-SB.

Waste Samples

Exterior waste sample SMS-01-WA contained 1,400 µg/kg of the pesticide beta-BHC, and exterior waste sample SMS-04-WA contained 53 µg/kg of dieldrin. The remaining waste samples contained small amounts of numerous pesticides. Sample SMS-03-WA also contained a trace amount of the Aroclor 1260 below the reporting limit.

No VOCs were detected in any of the waste samples but small amounts of the SVOC acetophenone were detected below reporting limits in samples SMS-05-WA, SMS-06-WA and SMS-07-WA. Phenol, below reporting limits, was detected in samples SMS-04-WA and SMS-07-WA, and phenanthrene, at concentrations below reporting limits, was also found in sample SMS-07-WA.

Detected metals included aluminum in concentrations up to 190,000 milligrams/kilogram (mg/kg) in the interior waste piles, zinc up to 99,000 mg/kg, copper up to 2,900 mg/kg and magnesium up to 15,000 mg/kg (Appendix B). Cyanide was detected in concentrations up to 3.4 mg/kg and arsenic was detected above the industrial RSL (1.6 mg/kg) in samples SMS-03-WA, SMS-04-WA and SMS-05 WA (Tetra Tech, 2009).

Surface Water Samples

The pesticide dieldrin was detected in surface water samples SMS-02-SW and SMS-03-SW at concentrations of 0.21 and 0.22 µg/L respectively (Table 1). Gamma-chlordane was also detected in samples SMS-02-SW and SMS-03-SW below reporting limits. However, both the dieldrin and gamma-chlordane concentrations exceeded the regional freshwater chronic surface water screening values (SWSVs). Samples SMS-02-SW and SMS-03-SW also contained small amounts of the VOC methyl ethyl ketone (MEK) and tetrachloroethylene (PCE) below reporting limits. In addition, the VOC (m & p) xylene was detected in sample SMS-02-SW at concentrations below the reporting limit (Table 4).

The SVOC phenol was detected in all four surface water samples with concentrations ranging from an estimated concentration of 2.2 µg/L to 8.3 µg/L. Samples SMS-02-SW and SMS-03-SW also contained 4-nitrophenol at estimated concentrations of 300 and 35 µg/L, respectively. A trace of caprolactam was also detected in sample SMS-04-SW. No PCBs were detected in any of the surface water samples.

Concentrations of aluminum, copper and lead exceeded background levels and Region IV freshwater chronic SWSVs in surface water samples SMS-02-SW, SMS-03-SW and SMS-04-SW (Appendix B). The RL for iron for SMS-03-SW exceeded the benchmark level. Mercury concentrations exceeded the SWSVs in samples SMS-02 and SMS-03-SW. The leachate seep sample (SMS-04-SW) generally contained the highest metal concentrations with aluminum at 23,000 µg/L, copper at 290 µg/L, iron at 14,000 µg/L and lead at 14 µg/L Mercury was not detected in the leachate sample but the RL exceeded the freshwater chronic SWSV. Mercury was detected above the freshwater chronic SWSV (0.012 µg/L) in samples SMS-02-SW and SMS-03SW at 0.25 and 0.20 µg/L respectively.

Sediment Samples

The pesticides dieldrin (tentative identification) and 4,4'-DDT were detected in sample SMS-02-SD at concentrations of 10 and 6.2 µg/kg respectively (Table 1). The 4,4'-DDT concentration exceeds the regional sediment screening value (SSV) of 3.3 µg/kg. Endrin aldehyde and 4,4-dichlorodiphenyldichloroethane (4,4'DDD) were also detected in trace amounts below reporting limits in sediment sample SMS-02-SD. Dieldrin and alpha-chlordane at 29 and 3.6 µg/kg respectively were detected in sediment sample SMS-03-SD, along with a trace amount of aldrin below reporting limits. Dieldrin and alpha-chlordane concentrations also exceed the SSVs in this sample. Alpha-chlordane at 3.8 µg/kg, and above the SSV was found in background sample SMS-01-SD. Aroclor 1260 was also detected in sediment sample SMS-02-SD below reporting limits at 44 µg/kg (Table 2) but above the SSV of 33 µg/kg.

The VOC methyl acetate at an estimated concentration of 2.4 µg/kg was detected in background sediment sample SMS-01-SD and various SVOCs, with concentrations below reporting limits, were found in all three sediment samples (Table 3). The highest detection was for the SVOC (3-and/or 4)- methylphenol at an estimated concentration of 240 µg/kg, also in sample SMS-01-SD.

Aluminum concentrations in samples SMS-02-SD and SMS-03-SD were an order of magnitude above background at 60,000 and 47,000 milligrams/kilogram (mg/kg), respectively, but no regional SSV has been established for the metal (Appendix B). Copper concentrations in the same samples were two orders of magnitude above background at 1,000 and 560 mg/kg and exceeded the regional SSV of 18.7 mg/kg. Arsenic and lead estimated concentrations, below reporting limits, exceeded the SSVs in all three sediment samples. Nickel and zinc concentrations in samples SMS-02-SD and SMS-03-SD also exceeded their respective SSVs of 15.9 and 124 mg/kg by one or more orders of magnitude.

Reactivity Testing

Both NH_3 and HCN were detected in all sample bags on receipt at the laboratory (Appendix A). NH_3 concentrations exceeded the instrument maximum detection limit of 200 parts per million (ppm) in the samples composited from the bottom of the upper and lower waste piles and in the sample composited from the middle of the piles. The bag ambient NH_3 concentrations in the composite sample from the tops of the waste pile and from the middle section of the lower pile were approximately 10 and 41 ppm respectively. The ambient HCN concentration in the mid-pile composite exceeded 180 ppm but was 10 ppm or less in the remaining samples.

Ambient concentrations of both NH_3 and HCN after the samples had been transferred to the reaction vessel were lower than those measured in the sample bag on arrival. However, increases in NH_3 concentrations with increases in temperature were measured in all of the samples except the middle zone composite where levels initially exceeded 200 ppm. Final NH_3 concentrations exceeded 200 ppm in all samples (Table 5). HCN concentrations in the pile bottom and top composites, which had decreased to non-detect before heating, increased by only 1 to 2 ppm throughout the tests. HCN concentrations in the middle composite and the sample from the middle of the lower waste pile initially decreased upon heating until temperatures exceeded about 45° C. The final HCN concentrations were 93 ppm and greater than 200 ppm respectively.

CONCLUSIONS

Concentrations of analytes in surface water and sediment samples collected downgradient of the site most often exceeded regional RSLs and, when compared to background concentrations, indicate that the East Branch of Flenniken Branch is impacted by runoff from the site. The most common exceedences were for chlorinated pesticides and metals. Arsenic concentrations in all soil and sediment samples also exceeded RSLs, including background samples but may be reflective of regional background arsenic concentrations rather than site related (Kopp, 2001).

Low chloride concentrations in the domestic well groundwater samples suggest that none of the wells were impacted by groundwater from the site.

The reactivity testing indicates that the waste from the interior of the site building is capable of generating both NH_3 and HCN, particularly at elevated temperatures, although the potential concentrations may vary within the waste piles depending on the waste composition.

REFERENCES

Kopp, Otto. C. 2001. Hazardous trace elements in Tennessee soils and other regolith. Tennessee Department of Environment and Conservation, Division of Geology: Report of Investigations No. 49. 135 p.

Lockheed Martin. 2007. Trip Report, Smokey Mountain Smelter site, Knoxville, Tennessee. (July 13, 2007).

TetraTech. 2009. Draft trip report, integrated assessment sampling event, Smokey Mountain Smelters. Technical Direction Document TTEMI-05-003-0001 (July 20, 2009).

Tables

TABLE 1
RESULTS OF PESTICIDE ANALYSES
SMOKEY MOUNTAIN SMELTER SITE
KNOXVILLE, TENNESSEE

Location	PESTICIDES													
	Aldrin	Dieldrin	alpha-BHC	alpha-Chlordane	beta-BHC	Endrin	Endrin aldehyde	4,4'-DDD	4,4'-DDE	4,4'-DDT	Endosulfan I	Endosulfan II	gamma-Chlordane	Heptachlor epoxide
DOMESTIC WELLS (µg/L)														
SMS-01 (Background)	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-02	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-03	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-04	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-05	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-06	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-07	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-08	U	U	U	U	U	U	U	U	U	0.036 J	U	U	U	U
SMS-09	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SURFACE SOIL (µg/kg)														
SMS-01 (Background)	U	7.0 N	U	U	U	U	40 N	U	U	U	U	U	U	U
SMS-02	U	3.0 J	U	U	U	U	U	U	U	U	U	1.1 J	U	U
SMS-03	U	2.0 J	U	U	U	U	U	U	2.3 J	15	U	U	U	U
SMS-04	U	1.8 J	U	U	U	U	U	U	U	U	U	U	1.5 J	U
SUBSURFACE SOIL(µg/kg)														
SMS-01 (Background)	U	U	U	U	U	U	U	U	U	U	U	U	U	U
WASTE (µg/kg)														
SMS-01 (Exterior)	U	U	U	U	1,400 N	U	U	U	U	U	U	U	1.1 J	U
SMS-02 (Exterior)	U	U	U	9.4	U	1.5 J	U	U	U	3.1 NJ	1.1 NJ	U	U	U
SMS-03 (Exterior)	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-04 (Exterior)	2.5 J	53	1.2 J	7.5 NJ	U	1.3 NJ	U	U	6.1 N	U	U	U	10 NJ	2.9 NJ
SMS-05 (Interior)	U	U	U	0.6 NJ	U	U	U	U	U	U	U	U	U	0.7 N J
SMS-06 (Interior	U	U	U	3.1 N	U	U	U	U	U	U	U	U	4	U
SMS-07 (Interior)	U	U	U	1.1 NJ	U	U	U	U	U	U	U	U	U	U
SURFACE WATER (µg/L)														
SMS-01 (Background)	U	U	U	U	U	U	U	U	U	U	0.041 J	U	U	U
SMS-02	U	0.21	U	U	U	U	U	U	U	U	U	U	0.021 J	U
SMS-03	U	0.22	U	U	U	U	U	U	U	U	0.042 J	U	0.020 J	U
SMS-04 (Leachate seep)	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SEDIMENT (µg/kg)														
SMS-01 (Background)	U	U	U	3.8	U	U	U	U	U	U	U	U	U	U
SMS-02	U	10 N	U	4.5	U	U	2.0 J	1.5 J	U	6.2	U	U	U	U
SMS-03	0.92 J	29	U	3.6	U	U	U	1.2 J	U	U	U	U	U	U

Only detected compounds indicated Highest value listed for duplicates
J = estimated below reporting limit
N= tentative identification
U = non-detect
µg/L = micrograms/liter
µg/kg = micrograms/kilogram

TABLE 2
RESULTS OF PCB ANALYSES
SMOKEY MOUNTAIN SMELTER SITE
KNOXVILLE, TENNESSEE

Location	Aroclor 1260	Aroclor 1254
DOMESTIC WELLS (µg/L)		
SMS-01	U	U
SMS-02	U	U
SMS-03	U	U
SMS-04	U	U
SMS-05	U	U
SMS-06	U	U
SMS-07	U	U
SMS-08	U	U
SMS-09	U	1.4
SURFACE SOIL (µg/kg)		
SMS-01 (Background)	U	U
SMS-02	U	U
SMS-03	U	U
SMS-04	U	U
SUBSURFACE SOIL (µg/kg)		
SMS-01 (Background)	U	U
WASTE (µg/kg)		
SMS-01 (Exterior)	U	U
SMS-02 (Exterior)	U	U
SMS-03 (Exterior)	0.012 J	U
SMS-04 (Exterior)	U	U
SMS-05 (Interior)	U	U
SMS-06 (Interior	U	U
SMS-07 (Interior)	U	U
SURFACE WATER (µg/L)		
SMS-01 (Background)	U	U
SMS-02	U	U
SMS-03	U	U
SMS-04 (Leachate seep)	U	U
SEDIMENT (µg/kg)		
SMS-01 (Background)	U	U
SMS-02	44 J	U
SMS-03	U	U

Only detected compounds indicated. Highest value listed for duplicates
U = non-detect J = estimated value below reporting limit
µg/L = micrograms/liter
µg/kg = micrograms/kilogram
mg/kg = milligrams/kilogram

TABLE 3
RESULTS OF SEMI-VOLATILE ORGANIC COMPOUND ANALYSES
SMOKEY MOUNTAIN SMELTER SITE
KNOXVILLE, TENNESSEE

Location	(3-and/or 4)-Methylphenol	4-Nitrophenol	Acetophenone	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Caprolactam	Chrysene	Fluoranthene	Fluorene	Indeno (1,2,3-cd)pyrene	Phenanthrene	Phenol
DOMESTIC WELLS															
SMS-01 (Background)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-02	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-03	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-04	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-05	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-06	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-07	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-08	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-09	U	U	U	0.038 J	U	U	U	U	U	U	U	0.030 J	U	0.031 J	8
SURFACE SOIL (µg/kg)															
SMS-01 (Background)	U	U	100 J	U	U	47 J	61 J	U	U	34 J	U	U	U	U	U
SMS-02	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-03	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-04	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SUBSURFACE SOIL(µg/kg)															
SMS-01 (Background)	U	U	77 J	U	U	U	U	U	U	U	U	U	U	U	U
SURFACE WATER (µg/L)															
SMS-01 (Background)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	2.2 J
SMS-02	U	300 J	U	U	U	U	U	U	U	U	U	U	U	U	8.3
SMS-03	U	35 J	U	U	U	U	U	U	U	U	U	U	U	U	7.5
SMS-04 (Leachate Seep)	U	10 J	U	U	U	U	U	U	1.7 J	U	U	U	U	U	2.7 J
WASTE (mg/kg)															
SMS-01 (Exterior)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-02 (Exterior)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-03 (Exterior)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-04 (Exterior)	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
SMS-05 (Interior)	U	U	0.059 J	U	U	U	U	U	U	U	U	U	U	U	0.065 J
SMS-06 (Interior)	U	U	0.071 J	U	U	U	U	U	U	U	U	U	U	U	U
SMS-07 (Interior)	U	U	0.15 J	U	U	U	U	U	U	U	U	U	U	U	U
SEDIMENT (µg/kg)															
SMS-01 (Background)	240 J	U	85 J	U	79 J	100 J	110 J	110 J	U	100 J	140 J	U	87 J	U	77 J
SMS-02	U	U	120 J	U	50 J	U	U	U	U	71 J	90 J	U	54 J	U	U
SMS-03	U	U	100 J	U	U	U	U	U	U	U	U	U	U	U	U

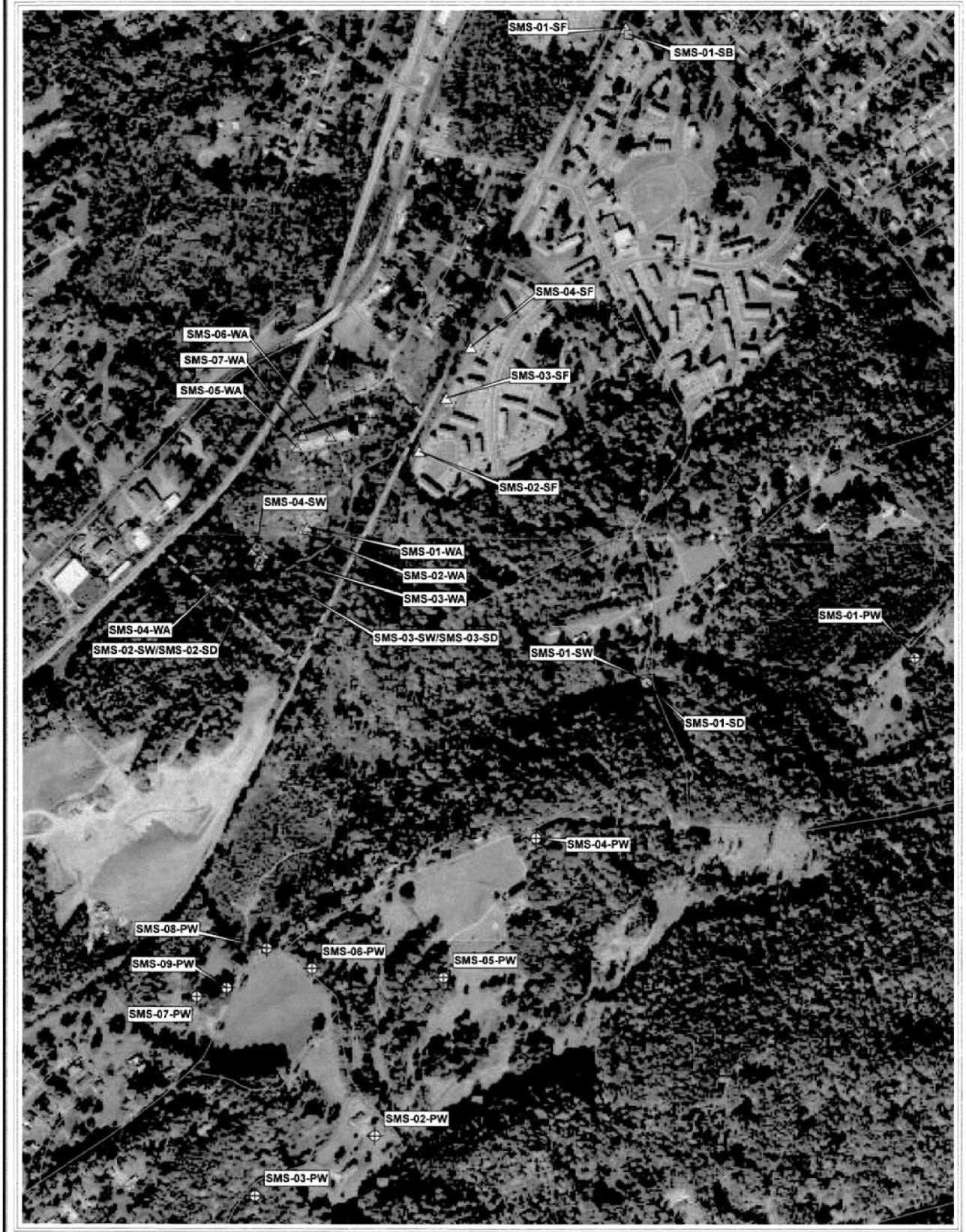
Only detected compounds indicated. Highest value listed for duplicates
U = non-detect J = estimated value below reporting limit
µg/L = micrograms/liter
µg/kg = micrograms/kilogram
mg/kg = milligrams/kilogram

TABLE 4
RESULTS OF VOC ANALYSES
SMOKEY MOUNTAIN SMELTER SITE
KNOXVILLE, TENNESSEE

Location	MEK	PCE	m & p Xylene	Methyl Acetate
DOMESTIC WELLS (µg/L)				
SMS-01 (Background)	U	U	U	U
SMS-02	U	U	U	U
SMS-03	U	U	U	U
SMS-04	U	U	U	U
SMS-05	U	U	U	U
SMS-06	U	U	U	U
SMS-07	U	U	U	U
SMS-08	U	U	U	U
SMS-09	U	U	U	U
SURFACE SOIL (µg/kg)				
SMS-01 (Background)	U	U	U	U
SMS-02	U	U	U	U
SMS-03	U	U	U	U
SMS-04	U	U	U	U
SUBSURFACE SOIL(µg/kg)				
SMS-01 (Background)	U	U	U	U
WASTE (µg/kg)				
SMS-01 (Exterior)	U	U	U	U
SMS-02 (Exterior)	U	U	U	U
SMS-03 (Exterior)	U	U	U	U
SMS-04 (Exterior)	U	U	U	U
SMS-05 (Interior)	U	U	U	U
SMS-06 (Interior	U	U	U	U
SMS-07 (Interior)	U	U	U	U
SURFACE WATER	U	U	U	U
SMS-01	U	U	U	U
SMS-02	1.1 J	0.50 J	0.75 J	U
SMS-03	1.1 J	0.50 J	U	U
SEDIMENT (µg/kg)				
SMS-01 (Background)	U	U	U	2.4 J
SMS-02	U	U	U	U
SMS-03	U	U	U	U

Only detected compounds indicated. Highest value listed for duplicates
U = non-detect J = estimated value below reporting limit
µg/L = micrograms/liter
µg/kg = micrograms/kilogram
mg/kg = milligrams/kilogram

Figures



Map created using DigitalGlobe (QuickBird) 30cm orthoimagery at 1:3,600 scale and site-survey GPS data. GPS collected in Lat., Lon., Decimal Degrees, WGS84.

Map Creation Date: October 2009

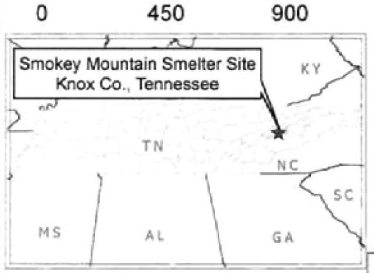
Coordinate system: Tennessee State Plane
FIPS: 4100
Datum: NAD83
Units: Feet

N
W E
S

Legend

- Subsurface Soil Sample
- Waste Pile Sample
- Well Sample
- Sediment Sample
- Surface Soil Sample
- Surface Water Sample
- Approximate Site Boundary
- Roads
- Stream
- Pond

0 450 900 1,350 1,800 Feet



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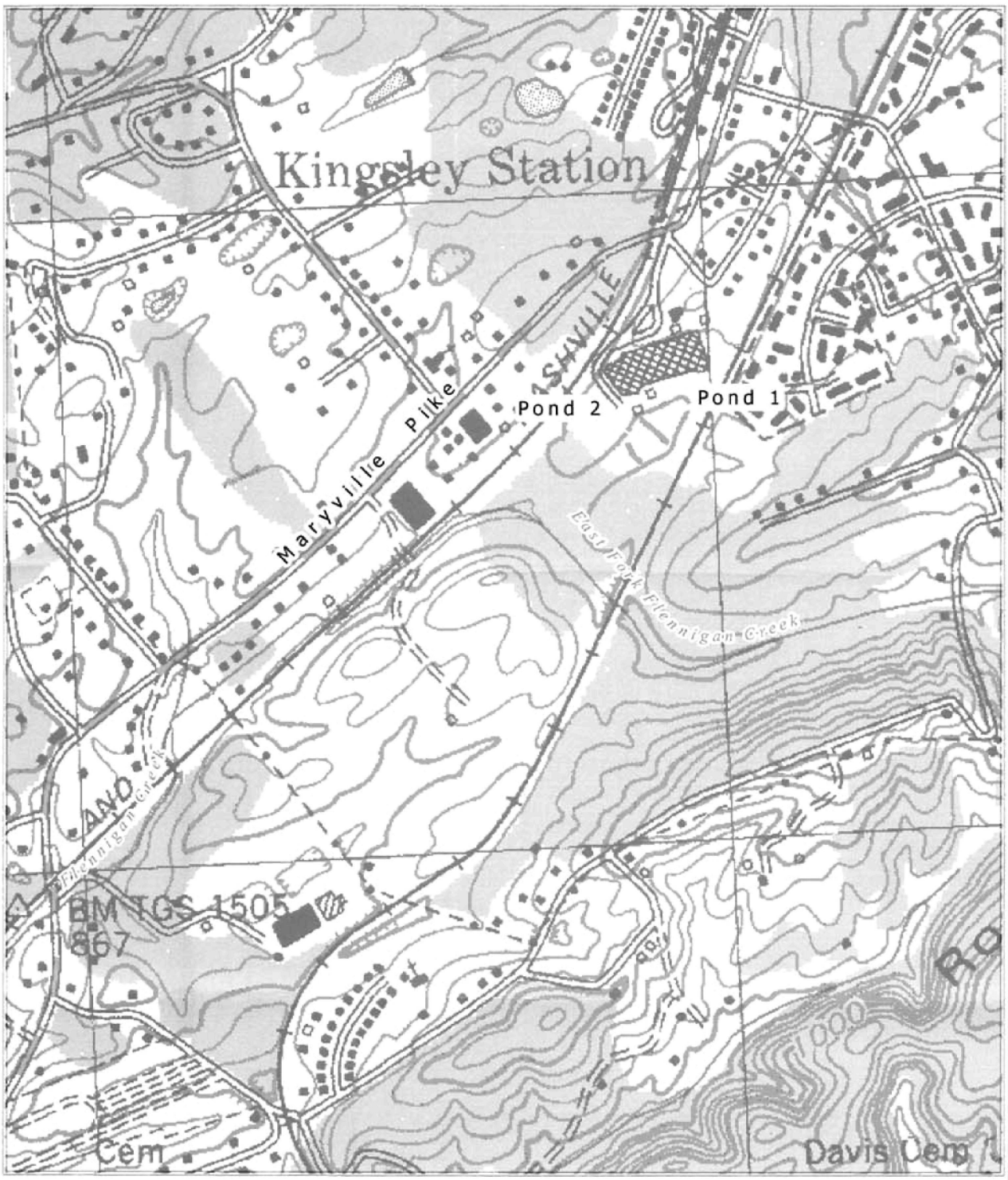
EP-C-04-032
W.A.# 0-182

Figure 1
Sample Location Map
Smoky Mountain Smelter Site
Knoxville, Tennessee



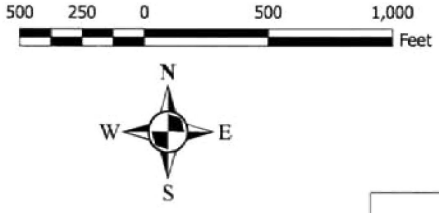
Map generated using USGS 1:24,000 topographic map.

Map Creation Date: October 2009

Coordinate system: Tennessee State Plane
FIPS: 3200
Datum: NAD83
Units: Feet

This USGS topographic map (c. 1986) shows the remaining berms for settling ponds 1 and 2. An earlier publication (c. 1966) of the of the Knoxville, TN quadrangle shows the ponds which have since been filled in.

At the time of publication of this map, the c. 1966 version was unavailable in a digital format but may be acquired through the USGS.



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MXD file: g:\arcinfoprojects\reac4\EAC00182_SmokyMtn\October2009_Report\182_topography_F2

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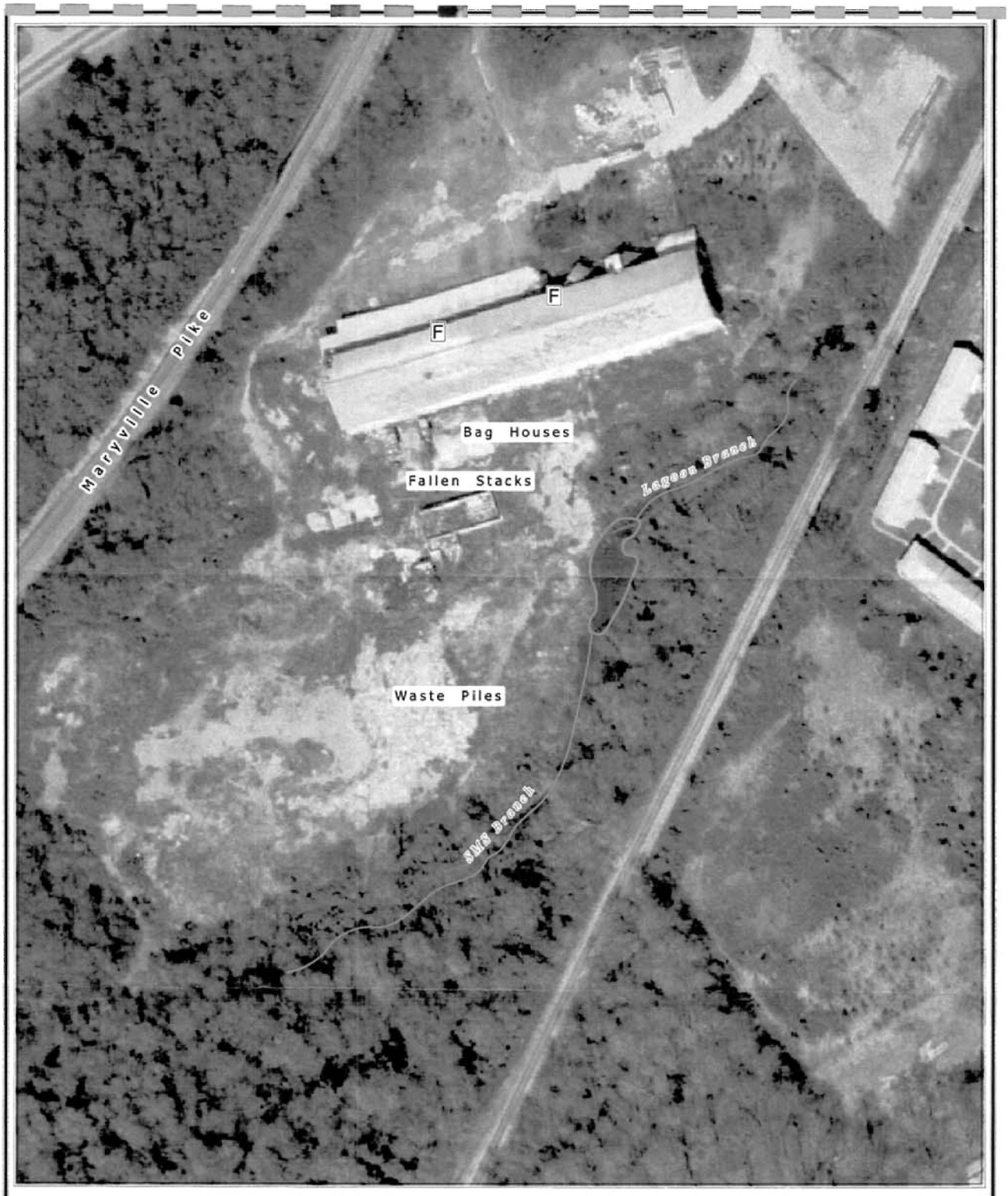
W.A.# 0-182

Figure 2
Topography
Showing Settling Pond Berm
Smoky Mountain Smelter Site
Knoxville, Tennessee



Map created using DigitalGlobe (QuickBird) 30cm orthoimagery at 1:3,600 scale and site-survey GPS data. GPS collected in Lat., Lon., Decimal Degrees, WGS84.

Map Creation Date: October 2009

Coordinate system: Tennessee State Plane
FIPS: 4100
Datum: NAD83
Units: Feet

100 50 0 100
Feet

N
W E
S

Legend

F Furnace Location Inside Building

Stream

Pond

Data: g:\arcviewprojects\reac4\00-182
MXD file: g:\arcinfoprojects\reac4\EAC00182_SmokyMountain\October2009_Report\182_sitefeat.remap_F3

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W.A.# 0-182

Figure 3
Location of Site Features
Smoky Mountain Smelter Site
Knoxville, Tennessee

Appendix A

APPENDIX A

LABORATORY NOTES -WASTE REACTIVITY TEST PROCEDURE

SMOKEY MOUNTAIN SMELTER SITE

KNOXVILLE, TENNESSEE

LABORATORY NOTEBOOK

PROJECT Smokey Mtn - 182 Notebook No. —
Continued From Page

Received 4 samples labled as follows:

~~Lower~~ Bottom
Middle of Lower Waste Pile (WA-1)
Middle composite of Side pile
Top composite of Side pile

SPLP fluid (Method #1312) for East of Mississippi made in batch for use in study (pH 4.2).

NH_3 installed & calibrated May 20th, 2009
HCN installed & calibrated May 20th, 2009

Tests conducted based on previous findings from 4/13/07, Smokey Mtn project, EEL Laboratory Notebook REHC IV-L-0178 (1/2004-1/2009)

In that test, a 2:1 (soil to fluid) ratio was determined to produce the most realistic slurry mixture. 100g of sample + 50mL of SPLP solution will be used for all tests.

Samples appear to be dry and free of water.

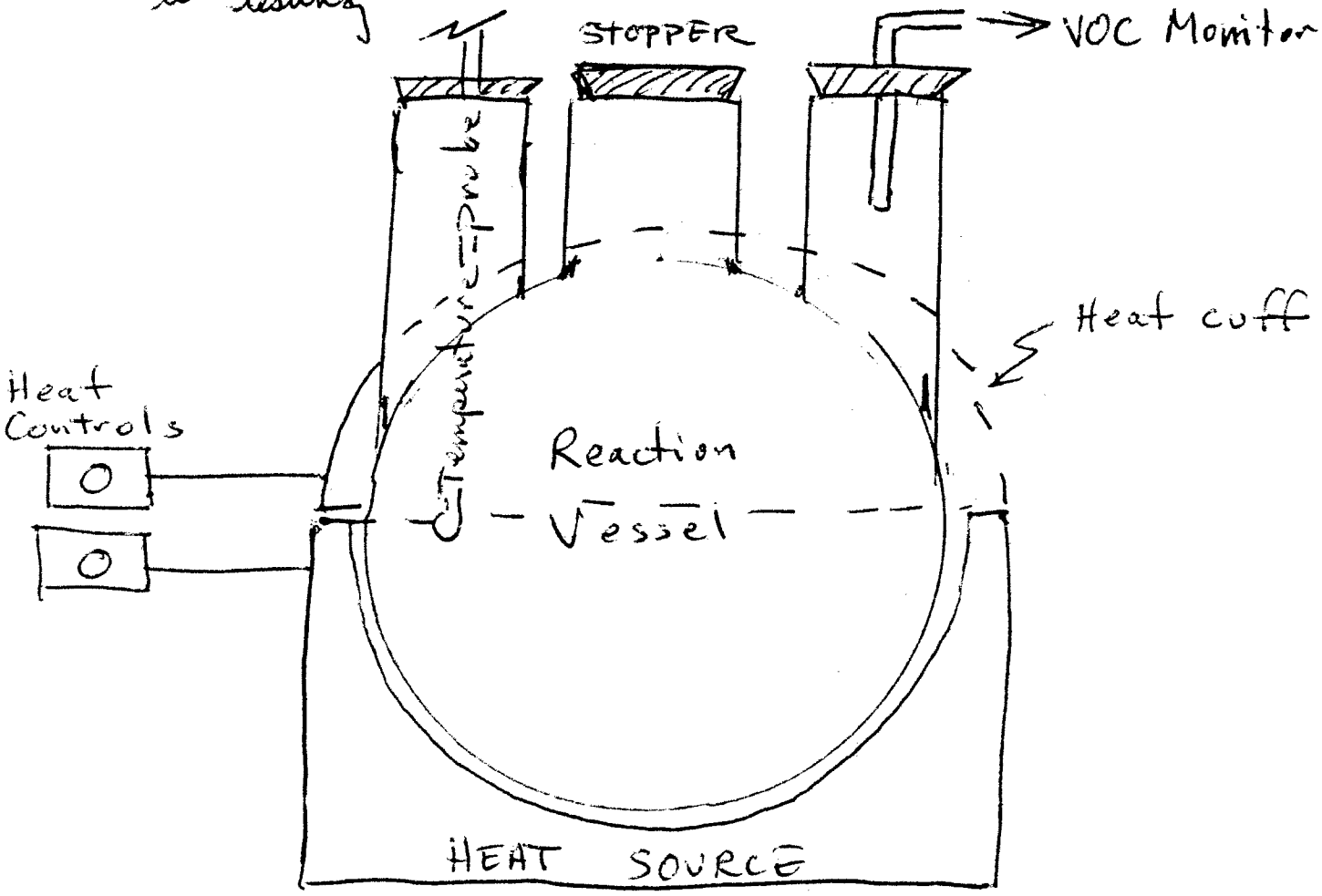
Headspace measurements of samples revealed the following peaks:

	NH_3	HCN
~~Lower~~ Bottom *	> 200	10
Middle of Lower	41	3
Middle	> 200	> 130
Top	10	5

* Note: Bottom sample mixed w/ open bag

Headspace measurements were taken at 68°F directly from the plastic zip-lock bags that the samples were shipped in.

Samples were sieved through a No. 18 (1mm) mesh opening to remove stones and debris prior to testing



Min. Rae Alarm set @ 25 ppm
Max reading is 199 ppm. Higher concentrations result in OVR text message on display.

SPLP fluid added after 1 min stabilization in vessel
Heat applied 1 min after mixing fluid and soil

Continued on Page

Read and Understood By

Test: Bottom

Time (min)	NH_3 ppm	HCN ppm	°C	
0	—	—	22°	
1	188	0	22°	No fluid / No heat
2				added 50 ml SPLP fluid
3	73	1	23°	began heating (setting #3)
4	81	2	26	
5	127	1	34	
6	176	1	40	
7	>200	1	47	
8				Test stopped as NH_3 peaked
9				over ~~the~~ maximum (200 ppm)
10				

Test: Middle of Lower Waste Pile (WA-1)

Time (min)	NH_3 ppm	HCN ppm	°C	
0	—	—	22	
1	>200	7	22	No fluid / No heat
2				Added 50 ml SPLP fluid
3	73	3	23	Began heating (setting #3)
4	81	1	23	
5	113	1	24	
6	192	1	26	
7	>200	0	29	
8	>200	1	34	
9	>200	90	45	moisture observed in tubing
10	>200	>200	52	*

* Possible that excessive moisture in VOC meter tube caused increase in HCN readings near end of test???

PROJECT Smokey Mtn - 182 Notebook No. Continued From Page 5

Test: Middle

Time (m)	NH_3 PPm	HCN PPm	Temp (°C)	
0	—	—	25	
1	>200	23	25	
2				Added 50ml SPLF
3	>200	6	25	Add Heat (setting 2
4	>200	6	25	
5	>200	2	28	
6	>200	2	31	
7	>200	2	34	
8	>200	1	40	
9	>200	23	46 (50)	Moisture observed
10	>200	93	~~93~~ 54	in tubing *

Test: Top

Time (m)	NH_3 PPm	HCN PPm	Temp (°C)	
0	—	—	24	
1	35	0		
2	29	0	24	Add 50ml SPLP fl
3	21	0	25	Add heat (setting 3
4	24	0	27	
5	28	0	32	
6	~~3860~~	0	38	
7	73	0	42	
8	105	0	47	
9	138	0	52	Moisture observed i
10	>200	1	59	tubing. *

Appendix B

APPENDIX B

SELECTED TABLES - TETRA TECH DRAFT TRIP REPORT*

SMOKEY MOUNTAIN SMELTER SITE

KNOXVILLE, TENNESSEE

Integrated Assessment Sampling Report, Smokey Mountain Smelters

0182-DTR-102309

TABLE 2
ANALYTICAL RESULTS FOR RESIDENTIAL WELL GROUNDWATER SAMPLES

Analyte	MCL	Background	Downgradient			
		SMS-01-PW	SMS-02-PW	SMS-03-PW	SMS-04-PW	SMS-05-PW
Volatile Organic Compounds (µg/L)						
Benzene	5.0	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Carbon disulfide	NE	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Chloromethane	NE	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Dichlorodifluoromethane (Freon 12)	NE	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Methyl ethyl ketone	NE	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ
Toluene	1,000	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Semivolatile Organic Compounds (µg/L)						
Anthracene	NE	0.093 U	0.095 U	0.093 U	0.093 U	0.095 U
Fluorene	NE	0.093 U	0.095 U	0.093 U	0.093 U	0.095 U
Phenanthrene	NE	0.093 U	0.095 U	0.093 U	0.093 U	0.095 U
Phenol	NE	4.6 U	4.8 U	4.6 U	4.6 U	4.8 U
Chlorinated Pesticides (µg/L)						
4,4'-DDT (p,p'-DDT)	NE	0.091 U	0.091 U	0.093 U	0.10 U	0.091 U
Polychlorinated Biphenyls (µg/L)						
PCB-1254 (Aroclor 1254)	0.5[a]	1.0 U	0.93 U	0.93 U	0.93 U	1.0 U
Chloride (mg/L)						
Chloride	250[b]	2.5	2.0	2.5	5.2	3.6

TABLE 2
ANALYTICAL RESULTS FOR RESIDENTIAL WELL GROUNDWATER SAMPLES

		Background	Downgradient			
Analyte	**MCL**	**SMS-01-PW**	**SMS-06-PW**	**SMS-07-PW**	**SMS-08-PW**	**SMS-09-PW**
Volatile Organic Compounds (µg/L)						
Benzene	5.0	0.50 U	0.17 J[1]	0.50 U	0.50 U	0.50 U
Carbon disulfide	NE	0.50 U	0.50 U	0.50 U	0.50 U	0.29 J[1]
Chloromethane	NE	0.50 U	0.50 U	0.50 U	0.50 U	0.11 J[1]
Dichlorodifluoromethane (Freon 12)	NE	0.50 U	0.50 U	0.50 U	0.20 J[1]	0.50 U
Methyl ethyl ketone	NE	5.0 UJ	5.0 UJ	5.0 UJ	30 J	5.0 UJ
Toluene	1,000	0.50 U	0.50 U	0.50 U	0.50 U	0.35 J[1]
Semivolatile Organic Compounds (µg/L)						
Anthracene	NE	0.093 U	0.095 U	0.095 U	0.095 U	0.038 J[1]
Fluorene	NE	0.093 U	0.095 U	0.095 U	0.095 U	0.030 J[1]
Phenanthrene	NE	0.093 U	0.095 U	0.095 U	0.095 U	0.031 J[1]
Phenol	NE	4.6 U	4.8 U	4.8 U	4.8 U	**8.0**
Chlorinated Pesticides (µg/L)						
4,4'-DDT (p,p'-DDT)	NE	0.091 U	0.091 U	0.091 U	0.036 J[1]	0.10 U
Polychlorinated Biphenyls (µg/L)						
PCB-1254 (Aroclor 1254)	0.5[a]	1.0 U	1.0 U	1.0 U	1.0 U	**1.4**
Chloride (mg/L)						
Chloride	250[b]	2.5	3.1	3.4	3.9	2.8 J

TABLE 3
ANALYTICAL RESULTS FOR SOIL SAMPLES

Analyte	EPA Regional Screening Levels Residential Soil	Background SMS-01-SF	Off Site - Residential Soil at Apartment Complex SMS-02-SF	SMS-03-SF	SMS-04-SF	SMS-04-SF-DUP
Semivolatile Organic Compounds (µg/kg)						
Acetophenone	7,800,000	100 J[1]	220 U	230 U	220 U	220 U
Benzo(a)pyrene	15	47 J[1]	220 U	230 U	220 U	220 U
Benzo(b)fluoranthene	150	61 J[1]	220 U	230 U	220 U	220 U
Chrysene	15,000	34 J[1]	220 U	230 U	220 U	220 U
Chlorinated Pesticides (µg/kg)						
4,4'-DDE (p,p'-DDE)	1,400	4.0 U	3.0 J	2.3 J[1]	4.3 U	1.2 J[1]
4,4'-DDT (p,p'-DDT)	1,700	12	1.8 J	15	4.3 U	1.5 J[1]
Dieldrin	30	7.0	3.0 J[1]	2.0 J[1]	1.8 J[1]	1.8 J[1]
Endosulfan II (beta)	NE	4.0 U	1.1 J[1]	4.4 U	4.3 U	4.3 U
Endrin aldehyde	NE	40	4.3 U	4.4 U	4.3 U	4.3 U
gamma-Chlordane	1,600[a]	2.1 U	1.2 J	0.77 J	1.1 J[1]	1.5 J[1]
Metals (mg/kg)						
Aluminum	77,000	16,000	9,500	15,000	9,500	9,700
Arsenic	0.39[b]	12 J	9.4 J	15 J	14 J	12 J
Barium	15,000	120	53	76	55	55
Beryllium	160[c]	1.6	0.62 UJ	1.0 J	1.2 J	1.1 J
Calcium	NE	9,900	2,000	2,700	3,300	3,400
Chromium	280[d]	32	21	36	14	15
Cobalt	23	20	13	19	17	13
Copper	3,100	25	32	20	21	22
Iron	55,000	41,000	23,000	42,000	35,000	33,000
Lead	400[e]	33 J	40 J	30 J	27 J	28 J
Magnesium	NE	2,100 J	520 J	840 J	840 J	800 J
Manganese	1,800[f]	1,300	1,300	1,800	1,600	1,400
Mercury	4.3[g]	0.062 UJ	0.065 UJ	0.052 UJ	0.36	0.039 UJ
Nickel	1,500[h]	13	4.9 J	5.0 J	11	8.3
Potassium	NE	1,200	610 J	960	920	950
Sodium	NE	46 J	82 J	30 J	16 J	18 J

TABLE 3
ANALYTICAL RESULTS FOR SOIL SAMPLES

Analyte	EPA Regional Screening Levels Residential Soil	Background SMS-01-SF	Off Site - Residential Soil at Apartment Complex SMS-02-SF	SMS-03-SF	SMS-04-SF	SMS-04-SF-DUP
Metals (mg/kg)						
Thallium	5.1[f]	1.8 J	2.1 J	3.2 J	2.8 J	1.8 J
Vanadium	550[f]	34	24	37	26	26
Zinc	23,000[g]	140 J	190 J	69 J	120 J	120 J

TABLE 4
ANALYTICAL RESULTS FOR WASTE SAMPLES

Analyte	EPA Regional Screening Levels Industrial Soil	Background SMS-01-SB	Exterior Waste Pile SMS-01-WA	SMS-02-WA	SMS-03-WA	SMS-04-WA	Interior Waste Pile SMS-05-WA	SMS-06-WA	SMS-07-WA
Semivolatile Organic Compounds (mg/kg)									
Acetophenone	100,000	0.077 J[1]	0.22 U	0.27 U	0.25 U	0.28 U	0.059 J[1]	0.071 J[1]	0.15 J[1]
Phenanthrene	NE	0.22 U	0.22 U	0.27 U	0.25 U	0.25 U	0.18 U	0.20 U	0.037 J[1]
Phenol	180,000	0.22 U	0.22 U	0.27 U	0.25 U	0.065 J[1]	0.18 U	0.20 U	0.077 J[1]
Chlorinated Pesticides (mg/kg)									
4,4'-DDE (p,p'-DDE)	5.1	0.0043 U	0.0043 U	0.0052 U	0.0049 U	**0.0061**	0.0036 U	0.0039 U	0.0038 U
4,4'-DDT (p,p'-DDT)	7.0	0.0043 U	0.0043 U	**0.0031 J**	0.0049 U	0.0049 U	0.0036 U	0.0039 U	0.0038 U
Aldrin	0.10	0.0022 U	0.0022 U	0.0027 U	0.0025 U	0.0025 J[1]	0.0018 U	0.0020 U	0.0019 U
alpha-BHC	0.27	0.0022 U	0.0022 U	0.0027 U	0.0025 U	0.0012 J[1]	0.0018 U	0.0020 U	0.0019 U
alpha-Chlordane	6,500[a]	0.0022 U	0.0022 U	**0.0094**	0.0025 U	**0.0075 J**	**0.00065 J**	**0.0031**	0.0011 J[1]
beta-BHC	0.96	0.0022 U	**1.4**	0.0027 U	0.0025 U	0.0025 U	0.0018 U	0.0020 U	0.0019 U
Dieldrin	0.11	0.0043 U	0.0043 U	0.0052 U	0.0049 U	**0.053**	0.0036 U	0.0039 U	0.0038 U
Endosulfan I (alpha)	NE	0.0022 U	0.0022 U	0.0011 J	0.0025 U	0.0025 U	0.0018 U	0.0020 U	0.0019 U
Endrin	180	0.0043 U	0.0043 U	0.0015 J[1]	0.0049 U	0.0013 J[1]	0.0036 U	0.0039 U	0.0038 U
gamma-Chlordane	6,500[a]	0.0022 U	0.0011 J[1]	0.0027 U	0.0025 U	**0.010 J**	0.0018 U	**0.0040**	0.0019 U
Heptachlor epoxide	0.19	0.0022 U	0.0022 U	0.0027 U	0.0025 U	**0.0029 J**	**0.00068 J**	0.0020 U	0.0019 U
Polychlorinated Biphenyls (mg/kg)									
PCB-1260 (Aroclor 1260)	0.74	0.043 U	0.043 U	0.052 U	0.012 J[1]	0.049 U	0.036 U	0.039 U	0.038 U
Metals (mg/kg)									
Aluminum	990,000	14,000	**150,000**	**130,000**	**120,000**	**140,000**	**140,000**	**190,000**	**150,000**
Antimony	410[b]	0.51 UJ	**1.1 J**	**1.3 J**	9.7 UJ	9.0 UJ	**3.5 J**	7.4 UJ	6.9 UJ
Arsenic	1.6[c]	**20 J**	1.4 UJ	R	**6.9 J**	**5.8 J**	**6.2 J**	1.2 UJ	1.2 UJ
Barium	190,000	140	200	66	85	180	190	29	32
Beryllium	2,000[d]	1.8	2.4	0.74 UJ	2.9	0.96 UJ	0.92 UJ	0.12 UJ	0.27 UJ
Cadmium	800[c]	0.64 UJ	0.54 J	0.75 UJ	0.81 UJ	**1.1 J**	0.34 J	**0.74 J**	**4.0 J**
Calcium	NE	4,700	**15,000**	**21,000**	7,800	**18,000**	7,400	7,600	5,700

TABLE 4
ANALYTICAL RESULTS FOR WASTE SAMPLES

Analyte	EPA Regional Screening Levels Industrial Soil	Background SMS-01-SB	Exterior Waste Pile SMS-01-WA	SMS-02-WA	SMS-03-WA	SMS-04-WA	Interior Waste Pile SMS-05-WA	SMS-06-WA	SMS-07-WA
Metals (mg/kg)									
Chromium	1,400[f]	36	88	61	**110**	98	71	45	42
Cobalt	300	38	9.1	2.5 J	10	6.8 J	7.8	4.5 J	2.6 J
Copper	41,000	42	**2,100**	**2,400**	**2,600**	**1,400**	**1,000**	**2,900**	**570**
Iron	720,000	38,000	7,600	11,000	19,000	44,000	27,000	3,100	5,200
Lead	800[g]	52 J	36 J	94 J	70 J	73 J	49 J	6.2 J	9.6 J
Magnesium	NE	960 J	**15,000 J**	**12,000 J**	**5,600 J**	**11,000 J**	**9,000 J**	**3,400 J**	2,000 J
Manganese	23,000[h]	2,600	220	860	500	880	180	66	76
Mercury	24[i]	0.11 UJ	0.062 UJ	0.15 U	0.16 U	**0.15**	0.11 U	0.12 U	**0.20**
Nickel	20,000[j]	6.4	**1,200**	**730**	**450**	**560**	**320**	**1,900**	**370**
Potassium	NE	810	2,400	77 J	720 J	770	**39,000**	**7,400**	2,000
Selenium	5,100	4.5 UJ	**7.0 J**	3.7 J	R	2.1 J	3.5 J	3.6 J	R
Silver	5,100	1.3 U	0.93 J	**1.7**	0.75 J	0.21 J	1.1 U	0.26 J	0.74 J
Sodium	NE	39 J	**3,500**	**820**	**1,900**	**12,000**	**51,000**	**79,000**	**82,000**
Thallium	66[k]	4.6	1.3 J	2.6 J	1.4 J	1.0 J	1.1 J	R	1.4 J
Vanadium	7,200[l]	40	50	38	54	100	40	31	45
Zinc	310,000[m]	36 J	**720 J**	**2,200 J**	**1,200 J**	**1,000 J**	**1,500 J**	**300**	**99,000**
Cyanide (mg/kg)									
Cyanide	20,000[n]	0.084 UJ	0.25 UJ	1 UJ	0.62 UJ	1.2 UJ	**3.4**	0.57 UJ	0.39 UJ

TABLE 5
ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES

Analyte	EPA Regional Screening Levels		Background - East Branch of Flenniken Branch	On-Site Perennial Tributary of the East Branch of Flenniken Branch			On-Site Leachate Seep
	Freshwater Acute	Freshwater Chronic	SMS-01-SW	SMS-02-SW	SMS-02-SW-DUP	SMS-03-SW	SMS-04-SW
Volatile Organic Compounds (µg/L)							
Methyl isobutyl ketone	NE	NE	10 U	10 U	1.1 J[1]	1.1 J[1]	10 U
Tetrachloroethene	528	84	5.0 U	5.0 U	0.50 J[1]	0.50 J[1]	5.0 U
m/p-Xylene	NE	NE	5.0 U	0.60 J[1]	0.75 J[1]	5.0 U	5.0 U
Semivolatile Organic Compounds (µg/L)							
4-Nitrophenol	828	82.8	10 UJ	**300 J**	**120 J**	**35 J**	10 UJ
Caprolactam	NE	NE	5.0 U	5.0 U	5.0 U	5.0 U	1.7 J[1]
Phenol	1,020	256	2.2 J[1]	5.8	**8.3**	**7.5**	2.7 J[1]
Chlorinated Pesticides (µg/L)							
4,4'-DDT (p,p'-DDT)	1.1	0.001	0.10 U	**0.035 J[1]**	**0.041 J[1]**	**0.042 J[1]**	0.10 U
Dieldrin	2.5	0.0019	0.10 U	**0.21**	**0.19**	**0.22**	0.10 U
gamma-Chlordane	2.4[a]	0.0043[a]	0.050 U	**0.020 J[1]**	**0.021 J[1]**	**0.020 J[1]**	0.050 U
Metals (µg/L)							
Aluminum	750	87	100 U	**7,500**	**4,500**	**1,100**	**23,000**
Antimony	1,300	160	1.0 U	**19**	**18**	20 U	**9.6**
Arsenic	360[b]	190[b]	1.0 U	**17**	**14**	20 U	**9.6**
Barium	NE	NE	23	43	34	30 U	36
Calcium	NE	NE	52,000	11,000	10,000	9,400	11,000
Chromium	984.32[c]	117.32[c]	5.0 U	30 U	30 U	30 U	**33**
Cobalt	NE	NE	5.0 U	30 U	30 U	30 U	**12**
Copper	9.22	6.54	10 U	**370**	**350**	**330**	**290**
Iron	NE	1,000	260	**3,900**	**2,200**	600 U	**14,000**
Lead	33.78	1.32	1.0 U	**12**	**10**	**7.9**	**14**
Magnesium	NE	NE	4,500	9,200	8,600	7,100	**19,000**
Manganese	NE	NE	59	**220**	**180**	120	**400**
Mercury	2.40	0.012	0.10 U	**0.25**	**0.22**	**0.20**	0.10 U
Molybdenum	NE	NE	10 U	**200**	**200**	**200**	**34**

TABLE 5
ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES

Analyte	EPA Regional Screening Levels		Background - East Branch of Flenniken Branch	On-Site Perennial Tributary of the East Branch of Flenniken Branch			On-Site Leachate Seep
	Freshwater Acute	Freshwater Chronic	SMS-01-SW	SMS-02-SW	SMS-02-SW-DUP	SMS-03-SW	SMS-04-SW
Metals (µg/L)							
Nickel	789.00	87.71	10 U	60 U	60 U	60 U	**34**
Potassium	NE	NE	1,000 U	**190,000**	**190,000**	**200,000**	**23,000**
Sodium	NE	NE	2,100	**5,000,000**	**5,100,000**	**5,200,000**	**1,300,000**
Strontium	NE	NE	130	58	60	57	64
Titanium	NE	NE	5.0 U	**34**	30 U	30 U	**72**
Vanadium	NE	NE	5.0 U	30 U	30 U	30 U	**25**
Zinc	65.04	58.91	10 U	**87**	**65**	60 U	**100**
Cyanide (µg/L)							
Cyanide (total)	22	5.2	15 U	**15**	**18**	**17**	15 U

TABLE 6
ANALYTICAL RESULTS FOR SEDIMENT SAMPLES

Analyte	EPA Regional Screening Levels Sediment	Background - East Branch of Flenniken Branch SMS-01-SD	On-Site Perennial Tributary of the East Branch of Flenniken Branch SMS-02-SD	SMS-02-SD-DUP	SMS-03-SD
Volatile Organic Compounds (µg/kg)					
Methyl acetate	NE	2.4 J[1]	15 U	9 U	6.5 U
Semivolatile Organic Compounds (µg/kg)					
(3-and/or 4-)Methylphenol	NE	240 J[1]	300 U	290 U	230 U
Acetophenone	NE	85 J[1]	120 J[1]	290 U	100 J[1]
Benzo(a)anthracene	300	79 J[1]	50 J[1]	290 U	230 U
Benzo(a)pyrene	300	100 J[1]	300 U	290 U	230 U
Benzo(b)fluoranthene	NE	110 J[1]	300 U	290 U	230 U
Benzo(k)fluoranthene	NE	110 J[1]	300 U	290 U	230 U
Chrysene	330	100 J[1]	53 J[1]	71 J[1]	230 U
Fluoranthene	330	140 J[1]	90 J[1]	72 J[1]	230 U
Indeno (1,2,3-cd) pyrene	NE	87 J[1]	54 J[1]	290 U	230 U
Phenol	NE	77 J[1]	300 U	290 U	230 U
Chlorinated Pesticides (µg/kg)					
4,4'-DDD (p,p'-DDD)	3.3	4.9 U	5.9 U	1.5 J[1]	1.2 J
4,4'-DDT (p,p'-DDT)	3.3	4.9 U	**6.2**	5.7 U	4.4 U
Aldrin	NE	2.5 U	3.0 U	2.9 U	0.92 J[1]
alpha-Chlordane	1.7[a]	**3.8**	3.5 U	**4.5**	**3.6**
Dieldrin	3.3	4.9 U	**8.7**	**10**	**29**
Endrin aldehyde	NE	4.9 U	2.0 J[1]	5.7 U	4.4 U
Polychlorinated Biphenyls (µg/kg)					
PCB-1260 (Aroclor 1260)	33[b]	49 U	**35 J[1]**	**44 J[1]**	44 U
Metals (mg/kg)					
Aluminum	NE	5,400	**59,000**	**60,000**	**47,000**
Arsenic	7.24	**10 J**	**17 J**	**13 J**	**22 J**
Barium	NE	34	73	66	75
Beryllium	NE	0.53 UJ	**1.7 J**	**1.7 J**	**1.2 J**
Calcium	NE	2,100	4,400	4,100	5,600

TABLE 6
ANALYTICAL RESULTS FOR SEDIMENT SAMPLES

Analyte	EPA Regional Screening Levels	Background - East Branch of Flenniken Branch	On-Site Perennial Tributary of the East Branch of Flenniken Branch		
	Sediment	SMS-01-SD	SMS-02-SD	SMS-02-SD-DUP	SMS-03-SD
Metals (mg/kg)					
Chromium	52.3	14	**160**	**68**	**94**
Cobalt	NE	10	13	11	14
Copper	18.7	8.5	**960**	**1,000**	**560**
Iron	NE	23,000	36,000	28,000	49,000
Lead	30.2	**33 J**	**71 J**	**62 J**	**54 J**
Magnesium	NE	480 J	**3,000 J**	**3,000 J**	**2,800 J**
Manganese	NE	590	970	790	1,200
Nickel	15.9	3.6 J	**200**	**200**	**110**
Potassium	NE	450 J	**1,900**	1,600	960
Silver	2	1.5 U	R	0.24 J	1.4 U
Sodium	NE	16 J	**10,000**	**8,300**	**5,100**
Thallium	NE	3.8 U	1.3 J	1.5 J	R
Vanadium	NE	17	**54**	49	**60**
Zinc	124	41 J	**560 J**	**470 J**	**350 J**